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MEETING PLACE

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THE UNIVERSITY MUSEUM

DISCOVERING NEW MINERALS

ATLANTIC RESEARCH

WANTED: A WINDOW ON THE UNIVERSE

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THE UNIVERSITY MUSEUM

Town and gown are reconciled in the variety and delight of a large collection

Dr. W. E. Swinton, Director

A University Museum is, by definition, a museum in a university. And there are hundreds of them. Departments of all kinds, from anthropology to zoology, have them, and they illustrate three-dimensionally many of the things that the professors discuss and that subsequently or contemporaneously the students can handle and examine from all angles. Recognition of many objects depends not only on appearance but on the feel of surface and weight, on smell, and even on the sense of taste.

The departmental museum is thus a close parallel to the departmental library and the student learns quickly that however valuable the texts may be, text-figures often leave much to be desired. Only the constant handling

and viewing of an object can develop that sixth sense of instant recognition of a part of the same thing when found, far from professors and text-books, in the field.

It is obvious that needs will differ according to the nature of the subject. The anatomist must learn instinctively to note features and their relationships. The palaeontologist must learn to recognize his specimens so thoroughly that he can identify even a fragment. Similarly the archaeologist and the collector of *objets d'art* must learn the techniques of instant recognition.

Of course, departmental facilities in most universities are limited by space and by the time that students can spend in the museums. The number of students and the amount of the departmental funds are also facts of prime importance. It comes about, therefore, that the amount of research, the development of new knowledge, as opposed to study and familiarization, that can be done in a departmental museum is limited. In but few universities are departmental museums large and nationally or internationally famous, or even open to the public. They are essentially parts of the teaching mechanism, and like other parts they are not achieved without travail. Someone has to decide to have the museum, to collect, select and to assure the safety of its materials, to rearrange them and renew them (where this is possible) after use. Here is, in fact, an excellent training ground for a senior student or graduate student.

Departmental university museum specimens should never be part of the series used in examinations, otherwise strange systems of recognition will be impressed upon them, not always to their scientific or artistic improvement.

Although the possession of a departmental library has never prevented the growth and use of the much larger, wider and educationally deeper University Library, the same logic is seldom applied to the departmental museum.

The University Museum ought to be not so much a museum in a university as of it. It should reflect a wide variety of arts and sciences, their co-mingling and interdependence; to provide at once an institution that gives background and foreground, and a wide survey of man's search and reasoning on a scale that no single departmental museum could ever do.

Nowhere could be seen better Francis Bacon's history of the Advancement of Learning—"men have entered into a desire for learning and knowledge, sometimes upon a natural curiosity and inquisitive appetite; sometimes to entertain their minds with variety and delight; sometimes for ornament and reputation—." Nowhere can reputation be obtained so certainly as in preparing the variety and delight that feed the natural curiosity of students. Yet all large and general museums must of necessity do this very thing. It may be of interest to recall the principles for museums laid down by Thomas Henry Huxley before the Commissioners for a Natural History Museum, in Manchester, in 1868. They are:

1) The public exhibition of a collection of specimens large enough to illustrate all the important truths of Natural History but not so extensive as to weary and confuse ordinary visitors.

2) The accessibility of the collection to the public.

3) The conservation of all specimens, not necessary to 1, in a place apart.

4) The accessibility of all objects in the museum to the curator or to scientific students without interference to the public or by the public.

5) Thorough exclusion of dust and dirt from specimens.

6) The provision for work-rooms and, if need be, for lecture rooms.

Obviously these principles apply to museums other than those of natural history and they emphasize the ideas of scope, display, storage, curatorship and research that characterize the great museums of the world despite the fact that some of the ideas have not yet been adopted in many museums. Numbers 1 and 4 are not practised in many large museums where too much is often displayed and too little is explained. Many curators imagine the collections to be their property without reference to the needs of any other section of the community, whether public or scholar.

The successful museum derives its authority from the range of its collections and the academic competence of its staff to interpret them and to advance knowledge thereby. It is all too easy for a curator to bask in the reflected glory of a famous collection built by others or in other days. Yet the successful museum need have no connection with a university. The British Museum, the British Museum (Natural History), and the Victoria and Albert Museum, all in the forefront of scholarship, are government institutions without connection with, or support by, universities. The members of the staff have officially no teaching duties, though occasionally, and by special arrangement, they may instruct small groups of students. The American Museum of Natural History has a connection with, but is not mainly supported by, Columbia University. Most of the world's large museums and galleries have no university authority.

The university museum differs from the publicly supported museum in the fact that a part of its audience will always be the undergraduate or the graduate. And they will be taught upon the collections by dually qualified professors—those with academic and museum experience. The collections used may be small and separate and the teaching may be done in a museum class-room. There is, however, no merit in a museum class-room *per se*. The teaching, to be useful, must be related to the width of a large collection. The invigorating presence of an inquiring mind and "the inquisitive appetite" is keenly felt by most university teachers. Conversely the student may expect that his studies will be illumined by access to the very objects on which advance of knowledge has been, or is being, made.

Since the university museum acts as a storehouse of research materials, a

mirror of university departmental discovery and for the promulgation of results recently achieved, the student should be exposed to an unusually rich educational stream.

The classicist or the student of the arts is casually, deliberately or subliminally exposed to science and the scientist to the arts. There should not be two cultures in the university museum. The environment of the museum may be urban but it should also be urbane, giving pleasure and beauty to many who have come for more strictly professional purposes. (See *The Complete Scientist*, Oxford University Press, 1961.)

If this analysis appears simple it must be remembered that the functions of museums are seldom probed by the visitor and, in too many minds, the university museum is regarded as something remote, divorced from public needs and usages. The latter idea is no more true than that the dictionary is for scholars and of little value to the ordinary man. All of us are, in fact, ordinary men or women outside our specialities, anxious to appreciate the beauty of the past and to try to grasp the wonders of the new age.

J. Percy Smith has high-lighted the misunderstanding in his splendid chapter in *A Place of Liberty* (p. 43). "The intellectual commitment of a university, then, is its responsibility for the extension of knowledge through discovery and re-assessment, and for the awakening of young men to intellectual excitement and challenge. That it is a noble function no civilized person would deny. Why then does its pursuit lead to constant tension between the university and the society in which it exists, some of whose highest purposes it is meant to serve?"

The university museum has a doubly increased challenge in that, on the one hand, it shows and tries to interpret the eclectic of university discovery and re-assessment for young men and older generations at several levels. This aim can only be attained if high levels of scholarship, combined with museum experience, are always at the call of the university departments and if there is satisfactory liaison between the museum and these departments. Cross-appointment of staffs on each side will help greatly in this co-mingling of experience.

On the other hand, nothing could be better than the sum of this research, teaching and academic publication, as a basis for the interpretation of the collections for the general public. The university museum thus provides an ideal meeting place for those with pride of university connection and for those who must view the academic scene from a much less involved point of view. The museum can do much to educate the public into a more favourable view and understanding of the work of the university and thus to create a lessening of the tension referred to and the creation of a more favourable climate of public opinion. This is, at least, what the Royal Ontario Museum attempts to do.

MOCTEZUMA'S TREASURES

Labwork uncovers five new minerals from Mexico

Dr. J. A. Mandarino, Associate Curator of Mineralogy

One day in September, 1960, an 8 × 10 inch package arrived on my desk from Scott J. Williams, a mineral dealer near Phoenix, Arizona. Inside was a note:

"Here are some specimens from a mine in Moctezuma, Mexico. Will you please check for emmonsite and mackayite? Some of the other minerals may be new."

I was immediately interested. I had heard of Scott Williams' remarkable talent for spotting rare minerals: on four separate occasions, he had turned up specimens which later were found to contain new species.

I had met him the preceding spring, when I was sent to Arizona to examine his private collection. He mentioned then how hard it was to get his material identified quickly. One of his new minerals took four years to completely study and publish, he told me. I was shocked by this delay, being relatively new to academic life then, and suggested that the ROM might do his identifications for him. He agreed to try us.

The first material to arrive that summer, in shipments #1 and #2, contained fairly routine minerals. It was the third shipment, the 8 × 10 package, that included the first hint of probable new species.

When I opened the package, I found eight specimens, varying in size from 1 × 2 to 2 × 3 inches. After looking at them with a hand lens, I put the most promising ones under a binocular microscope. As I slowly turned them over, my interest quickened. Embedded in the rocks were a number of unrecognizable minerals. Some very small yellow crystals. Some perfectly formed brown crystals. A few purple cleavage masses. A great many green cleavage masses. For easy reference, I called the unknowns Minerals A, B, C, and D.

Mineral A was in such small quantity that I set it aside and turned to Mineral B, the small brown crystals. I quickly prepared a sample for x-ray analysis. X-raying an unknown mineral is a sophisticated way of fingerprinting a suspect. A small amount of material (one milligram) is ground up, mixed with nail polish to bond it, pressed in the shape of a cylinder, and mounted on a rod in the x-ray camera. X-rays from the machine strike the planes of atoms in the specimen, bounce off, and hit the film. When the film is developed, it looks no more like the external mineral than a skeleton

looks like a body. The developed "picture" shows a series of black curves against a grey background. The positions of the curves, and their intensities, distinguish one mineral from another.

I checked the developed pattern for Mineral B with our files. None of our patterns matched it. This did not prove it was new, however. Our files, like most x-ray files, are incomplete. Somewhere, there might be a match.

Adopting a different tack, I next removed a small sample for a spectrographic analysis at the Ontario Department of Mines. A spectrographic analysis might or might not help us. The instrument can detect many of the elements which in nature combine to form minerals. Mineral B might not contain these particular elements, or it might contain only common elements like silicon, iron, or calcium, which occur in so many minerals their presence isn't conclusive.

When I opened the report from the Department of Mines, I was gratified to read that Mineral B contained, among other things, tellurium. There were only six known non-metallic tellurium minerals. I had already checked their x-ray data against Mineral B's. None matched. Therefore, Mineral B had to be new.

More good news followed. Minerals C and D also contained tellurium. They also showed different x-ray patterns from the known tellurites, and thus also had to be new.

Meanwhile, a second package had arrived from Scott Williams with another unrecognizable mineral, Mineral E. This also turned out to be new, for the same reasons.

Here were possibly five new minerals, all from one mine in Moctezuma. To find so many new minerals from the same spot is rare, but not unique. Why does one locality produce five, when, to date, the investigation of the whole earth has only yielded 2,000? Actually, no one knows for sure. In this case, we can guess very little because we haven't had access to the mine to study the occurrence first-hand. It must have been the chance mingling of a rare element, tellurium, with common elements like zinc, manganese, and iron. Unusual temperature variations or pressures probably caused the solutions carrying these elements to crystallize. But the creation of minerals in nature, like the creation of life itself, still baffles the scientist. A great deal has been written about it, but very little has been proved.

Needless to say, I was fired with enthusiasm by our finds. However, the real work had only begun. It's not enough merely to identify a new mineral. Before a new mineral can be useful to anyone, it must be thoroughly studied, and the results published.

Nor can a new mineral description be as brief as a birth announcement. Fellow scientists are not beguiled by simple statistics like the newcomer's name and weight. There are more than 12,000 mineral names in the literature.

The number of valid mineral names is about 2,000. That leaves 10,000 mistakes. Fifty years ago, these mistakes were often caused by lack of communications and modern technological equipment, but even in the past ten years, fewer than half of all proposed new mineral names were considered acceptable.

In 1960 an International Commission on New Mineral Names was set up to see that any name that got into the literature was a valid one. Requirements for a new description were made both rigorous and thorough.

I surveyed the four new minerals. Mineral D, the green cleavage masses, was the most abundant, so we began on that. Prof. R. S. Mitchell, at the University of Virginia, did the single crystal x-ray work for us, as we had no camera ourselves, and in due time the study was completed. We named Mineral D "denningite", for Prof. R. M. Denning at the University of Michigan.

But the course of research, like true love, never runs smooth. All the other minerals posed the same problem: a dearth of material. I spent months with Mineral C, getting 500 milligrams for a chemical analysis. Five hundred milligrams occupies about the same space as two aspirins and sounds ridiculously small, until you start trying to accumulate it, grain by grain. It was firmly embedded in the matrix, not all in one convenient location, but scattered here and there throughout the specimen. And it was brittle. I would often work five minutes trying delicately to tweeze a fragment of the material free; only, at the very last moment, to press down too hard and have it crumble under my hand.

After much tedious work, I finally accumulated a pure concentrate of 500 milligrams, had it analyzed, and eventually finished the study. Mineral C was named "spiroffite", for Prof. K. Spiroff, of Michigan Tech.

But the other two minerals were impossible to study: there simply was not enough material for an analysis. Work came to a standstill for months.

And then one day a happy coincidence occurred. Mr. D. C. Harris, a graduate student under Prof. E. W. Nuffield of the department of geological sciences (Faculty of Arts and Science), having finished his course work, joined our department at the Museum. In talking to us about his thesis, he said he had devised a new method for analyzing minerals by x-ray spectrography. And he needed only one to two milligrams of material for samples!

We were in business again. Although the museum has no x-ray spectrograph, the department of geological sciences kindly allowed us to use theirs. We are now working out what we hope is the last of the problems with Minerals B and E.

Of the five unknown minerals, then, two are completed and two are in progress.

That leaves Mineral A. Its x-ray pattern matches that of lead-oxy-fluoride, a synthetic compound. However, an electron probe analysis for lead revealed no lead. The only element reported was tellurium. Unfortunately, we have no more than five milligrams of Mineral A, at most. The fragments are so nearly invisible, I can't be sure that a milligram removed for x-ray fluorescence work might not contain a fine-grained mixture rather than the pure mineral. They're too precious to risk losing.

Someday, its secrets may be revealed. We may be able to collect additional material from the mine where it was found. Or we may be able to synthesize the mineral.

In the meantime, Mineral A sits upon the shelf in my office, silent and inscrutable . . .

SOUTHERN VISITORS IN THE SEA

An inland museum embraces the Atlantic

Dr. W. B. Scott, Curator of Ichthyology

The first comprehensive guide to the fishes of our Atlantic coast[1] has just gone to press after many years of research—and the only thing of which we are certain is that by the time it appears for sale, it will be out of date. One of the most important things we have learned in writing it is how little we really know about a natural resource which has been one of Canada's mainstays for four centuries.

About 300 species of marine fishes are to be found during the year off our eastern coastline. The exact number is not known. Every day seems to yield new distribution records: a species new to a particular area has been spotted by a research worker or caught in a trawler's net. Above all, we have found that most of our quarry are not Canadian fishes at all, but more properly should be regarded as international, our newly-established 12-mile limit notwithstanding. About 40 per cent of them are in fact representative of southern waters. That is, they move northward in summer in waters under the Gulf Stream influence into the Canadian area. Not all species move northward every year, but our limited observations do not allow complete recording.

[1]*Fishes of the Atlantic Coast of Canada.* By A. H. Leim and W. B. Scott (to be published by the Fisheries Research Board of Canada).

The life of the north Atlantic is the subject of co-operative studies by agencies in all the countries along its shores. The ROM's interest in this general field has involved field trips from Newfoundland to the West Indies, and has been aided by other scientists in Britain, Denmark and the U.S.

Why is an Ontario museum, nearly 1,000 miles from salt water, active in this work? The most important reason is our research collection, which has the largest selection of Atlantic species available in Canada. Collections of individuals of both sexes, each represented in varying stages of maturity, are essential whenever the fauna of an area is being studied. Without a large number of specimens positive identification is often impossible because of variations in form, pigmentation and internal structure imposed on the animal by both its environment and genetic background. In our gallery of Canadian fishes we have 223 specimens mounted; but for every fish in the gallery, we have 1,000 or more preserved in alcohol, and filed on shelves for reference. This is an immensely valuable research tool, constantly used by colleagues across Canada and in many other parts of the world.

Another reason for our interest in Atlantic fishes is that Toronto is much closer to this subject than most of its inhabitants realize. Many fishes which occur in Lake Ontario (on the city's doorstep, so to speak) have come from the Atlantic. The sea lamprey, smelt, white perch, and eel are all fishes of Atlantic origin. You can catch eels off Toronto waterfront piers, and because they are a food fish prized by many European immigrants they are the object of a small but growing industry in Lake Ontario. Yet every eel caught had its birthplace in the romantically named Sargasso Sea, which lies east of the Bahama Islands. And every one that escapes the fisherman, and reaches maturity, will migrate back down the St. Lawrence River to the ocean to take part in the procreation of its kind in that area. The movements and spawning of larval and adult eels are phenomena broadly understood, but after 40 years of study their details are not known.

The museum's interest in Atlantic fishes commenced as early as 1923 but has become more serious within the last ten years. It received considerable impetus first in 1955 with the building of the gallery of Canadian fishes, which was a joint project between the Royal Ontario Museum and the Department of Fisheries of Canada, and more recently by a cooperative project with the Fisheries Research Board of Canada in the preparation of the *Fishes of the Atlantic Coast of Canada.* This work made very obvious many deficiencies in the reference collection of the Museum and indeed in Canadian collections generally.

Work continues with the Fisheries Research Board on a number of problems involving the identification of Atlantic fishes. In addition, other members of the museum's ichthyology department are carrying on their own studies. Dr. Dymond, Honorary Curator and Emeritus Professor of

Zoology has recently published his extensive account of the Atlantic salmon. Mrs. Radforth, Research Associate, is working on problems relating to the various species of lanternfishes (family Myctophidae) and their distribution in the Atlantic region. These are small, deep sea fishes that possess luminescent organs on the body and occur in enormous numbers throughout the world. She has just returned from a visit to the British Museum (Natural History) in London, where she was privileged to work with one of the world's most important collections of lanternfishes. And, in cooperation with the department of zoology, a graduate student from Pakistan is working on a problem involving the cranial and visceral osteology of the cods (family Gadidae). Canadians need no introduction to the cod. Not that we are ignoring our domestic waterlife. Dr. E. J. Crossman, the Associate Curator, for example, is pursuing a long-term and complex study of a group of Ontario game fishes, the muskellunge and pikes, in all their hybrid variety.

Of all the new material coming to light, one of the most fascinating is the extent to which southern fishes form a significant part of the fauna of Canadian waters. This has only really begun to be appreciated although it has long been known that there was an increase in summer visitors in certain years. The launching in 1958 of a new Canadian research vessel, the *A. T. Cameron*, has greatly increased the opportunities to record changes in the fish populations.

While smaller varieties, such as the triggerfishes and filefishes, are more likely to escape notice, we are rapidly expanding our knowledge of the northward migrations of such large fishes as sharks, tunas, marlins, and swordfish. The travels of the tuna are among the most dramatic of any creature. The bluefin tuna (locally called "horse mackerel") that visit the shore waters of Newfoundland and Nova Scotia in summer and fall, to be caught with increasing frequency by Canadian commercial and sport fishermen,[2] leave the West Indies in the spring. Some idea of the full exent of their travels has resulted from the tagging of adult tuna by sportsmen under the guidance of biologists from Wood's Hole Oceanographic Institution. Although relatively few fish have been tagged there have been five transatlantic crossings recorded since 1961, and in 1962 two large tuna tagged off the Bahamas were taken by purse seiners off Bergen, Norway just

[2]A sad story in The Varsity on Sept. 23, relating the results of the Ninth Annual Intercollegiate Fishing Match at Wedgeport, Nova Scotia, at which the University of Toronto did not catch a tuna and stood last among ten teams, came as a surprise to the ichthyologists in the ROM. The museum's staff were more successful in their fishing efforts, for at about the same time the U. of T. team was returning empty handed, the museum's catch of Atlantic fishes, which included tunas as well as swordfish, white marlin and dolphin, was being received from the express company at the back door.

50 days later. This recapture occurred 5,000 miles from the tagging site, and assuming a straight-line trip which is thought unlikely, required a minimum cruising speed of 100 miles a day.

Of the 18 species of sharks known to occur in the Canadian Atlantic area, more than half are southern forms that are apparently at their northern limit of range in the Western North Atlantic or are wide-ranging oceanic forms that move into our area during summer months. Examples of such migrants are the white, blue, thresher, basking, dusky, whitetip and mako sharks. Until the capture of a specimen in 1962 the mako shark was not thought to occur in the shelf waters of the western Atlantic, north of Cape Cod. At least two more records were obtained in August of this year suggesting that its occurrence is not so rare as supposed.

One of the more dramatic Canadian commercial species that follows this north-south migration pattern is the swordfish. Canadian commercial fishermen catch this fish on the Newfoundland and Nova Scotia fishing banks in summer and fall and then follow the fish southward during the winter months. Some Canadian fishermen travel as far south as Cape Hatteras.

Many smaller fishes, particularly deep sea forms, also suggest relationships with more southern latitudes. Because of the greater uniformity of environmental conditions in the deep seas compared with surface waters, some deep sea species are believed to be very wide-ranging. However, although data are fast accumulating, these creatures are still poorly known, largely because of the difficulty of capturing animals at great depths. But this past summer, for example, a fish less than three inches long was caught off Sable Island by biologists of the Fisheries Research Board. It was a member of that interesting group of deep sea forms equipped with photophores or light organs. Although there are many different species occurring in the western Atlantic this particular form has not been recorded north of the Gulf of Mexico—a striking indication of the limited state of our knowledge.

As part of the museum's attempt to understand better the North Atlantic fish fauna, efforts have been extended to the south, and there is now a significant and growing collection of West Indian fishes in the museum's study collection. Some of the fishes that have been recorded off the Canadian coast came from even farther away. Just two years ago a fishery scientist in Newfoundland found an oceanic puffer that must have travelled from the east coast of Africa. Only one previous occurrence in western Atlantic waters had been reported, and that from Bermuda.

Events such as these emphasize the limitations of our knowledge of Atlantic fishes, the kinds that exist, their movements and migrations—and provide thrilling encouragement to the people who are engaged in their study.

CASE FOR THE STARS

The ROM *seeks a big new educational tool*

Dr. V. B. Meen, Chief Mineralogist

Astronomy has always had a place in the Royal Ontario Museum. Some of the first objects on display, when our doors opened in 1914, were meteorites—those mysterious visitors from space which are the only concrete evidence we have of conditions beyond the earth. We had eight of them then. Today the collection has grown many times, and while ours cannot be classed among the great meteorite collections of the world, it is important because so many varieties are represented. They tell us, we think, of a planet which once orbited between Mars and Jupiter; they also afford clues to the structure of our own earth's interior where no drills have reached. They are an integral part of the evidence in the never-ending attempt to unravel our past, explain our present and forecast our future.

While most meteorites are small, some in the past have been quite large and their arrivals on earth have been accompanied by gigantic explosions which created large craters. In 1950 and 1951 the Royal Ontario Museum and the National Geographic Society together studied the site of Chubb Crater in Ungava, Quebec, and since that time we have cooperated again at Merewether Crater in northern Labrador. The study of these and other circular structures in Canada has assumed new importance as man approaches the first flight to the moon; we hope they will tell us more about similar craters which pock our nearest neighbour in space.

Then, the department of geology deals with the origins of the earth and the processes which have been active in its crustal regions during the past 4,500,000,000 years. Such interest means of course that our geologists are interested also in the origin of other members of the solar system, and the processes which may be taking place in and on at least some of the nearer members. Various theories of creation, from the most ancient to the most recent, are explained in a striking series of displays.

These examples demonstrate that throughout our history we have been interested in astronomy. They also show how relatively little we have been able to do. Now, in a period when man is becoming more aware of his partnership in a system much greater than our earth and moon, it becomes evident that we must expand our work in this field. Through the medium of display which is the forte of the museum, we must offer to our half million visitors each year an opportunity to become acquainted with at least

the rudimentary aspects of the universe, its principal members, their motions and inter-relations. In this work I feel certain that we can call on the expertise of two other parts of the University of Toronto—the department of astronomy and the David Dunlap Observatory—and of the Royal Astronomical Society of Canada, Toronto Centre.

Of all possible exhibits in astronomy, the most effective to the layman undoubtedly is the planetarium. Some of you have visited planetaria while others may have only a vague idea of what they can do. I have lost track of the number of planetarium programmes I have seen, but one thing I have not lost. As the lighting gradually lowers through the supposed sunset depicted on the auditorium dome, and I wait for the show to begin, there comes a moment when the light is gone and the stars appear. And every time this happens, I experience the same emotion that I have felt countless times when I have stepped out of my tent or cabin in the wilderness and found the stars in their infinity blazing down at me. There are no clouds, smog or city lights. I am still in my comfortable chair in an air-conditioned room, but the finiteness has been replaced by infinity.

When planetaria in their modern form were first installed in the 1930s, it was characteristic that the lecturer would put the instrument through its paces. During an hour he would demonstrate the diurnal rotation of the heavens; the geocentric motions of the sun, moon and inner planets; the 26,000-year precessional motion of the firmament; views of the heavens from various latitudes such as the polar regions and the equator. He would take the audience back in time to view the sky on the night of some great historical event, or speed the motion of the stars to preview a night far in the future.

In North America, this has changed. The lecturer no longer salaams before the magnificent instrument. Rather, he ignores it and uses it as a tool—a very intricate and expensive tool to be sure, but still a tool—just as we use telescopes and microscopes. No longer does the lecturer try to demonstrate all astronomy in one lesson which will last the viewer for the rest of his life. Now a lecture is centred on one phase of a subject in detail, and a month or two later the audience is welcome to return for another lesson.

On a recent visit to New York's Hayden Planetarium, I was treated to a beautifully organized lecture on the moon. Various theories of its origin were followed by demonstrations of its position and movements relative to the earth and sun, a discussion of possible origins of the seas and craters on its surface, and some theorizing about conditions which will greet explorers when they step from their space vehicle onto its surface. All this was done under a starry sky by means of the planetarium instrument and auxiliary projectors, including a motion picture projected near the zenith amid the stars. It happened that that lecture was attended by about 800 grade seven

schoolchildren and their teachers. What a magnificent lesson they got that day!

On another occasion I sat in on a very special programme in the same planetarium. The audience of possibly 100 was composed of New York University students who were studying surveying. That night they got a demonstration on the use of the stars in determining exact locations on the surface of the earth.

Planetaria have been used in research projects dealing with animal behaviour, particularly in experiments on the migration of birds, since by twisting a few knobs the sky for any point on earth and for any night of the year may be produced with fidelity. Some have been used in the training of pilots, navigators and, more recently, astronauts.

Major planetaria are to be found in many parts of the world. Several were destroyed in Europe and Japan in World War II but many of these now are being replaced. There are planetaria in Peking and Calcutta and one is nearly completed in Bangkok. In South America there is one in Sao Paulo, Brazil, and one building in Caracas, Venezuela.

Toronto is the largest city in North America without a planetarium, and major ones are to be found in a number of cities of much smaller size. No major planetarium exists in Canada, although one is planned for Montreal and another for Calgary. Toronto's is long overdue.

It has been demonstrated that a planetarium is most successful when located close to a centre which also attracts large numbers of visitors. As examples, there are the Hayden of the American Museum of Natural History in New York, the Fels of the Franklin Institute Museum in Philadelphia, and the Buhl in the Carnegie Museum, Pittsburgh. All offer several lectures a day. In contrast to this is the Adler Planetarium in Chicago, rather isolated down by the shore of Lake Michigan, which has a very sparse weekly schedule.

Toronto needs and can support a planetarium and its place is with the Royal Ontario Museum. There, it can serve as the centre around which a museum of astronomy and physics can develop. It can teach astronomy to our schoolchildren, to our university students and to our population in general. Its professional staff will be academically qualified to hold teaching appointments in the University of Toronto department of astronomy and the David Dunlap Observatory—both of which have offered full support towards this goal.

The cost of a planetarium is high and I am not certain yet how we will obtain the necessary funds. Funds for planetaria, in other parts of North America, have been obtained in a variety of ways. Several have been provided through gifts by individuals or foundations, and each bears the name of the generous donor. One has been provided by a Board of Education. At least

one has been built by a university. One is being built by civic funds, and still another is being built with funds raised through public subscription. The one planned for Montreal is financed for the advertising it may provide and Calgary's is to be a Centennial project. Surely we will find support for a major planetarium in Toronto.

(This article was taken from an address by Dr. Meen to the Royal Astronomical Society of Canada, Toronto Centre. Shortly afterwards, Dr. Meen received the first pledge of assistance: a $10,000 bequest which is conditional on the ROM and RASC establishing a major planetarium before 1970.)